Better Buildings
U.S. DEPARTMENT OF ENERGY

Zero Energy Buildings:
What are they and how do we build them?

April 7, 2015
3:00-4:00 PM EDT

U.S. DEPARTMENT OF ENERGY

Overview and Agenda

- Welcome and Overview
- National Institute of Building Sciences
- Rocky Mountain Institute & McDonald's
- Walgreens
- Additional Resources
- Question & Answer Session

Today's Presenters

Name		Organization
Roger Grant		National Institute of Building Sciences
Roy Torbert		Rocky Mountain Institute
Roy Buchert		McDonald's
Jason Robbins		Walgreens

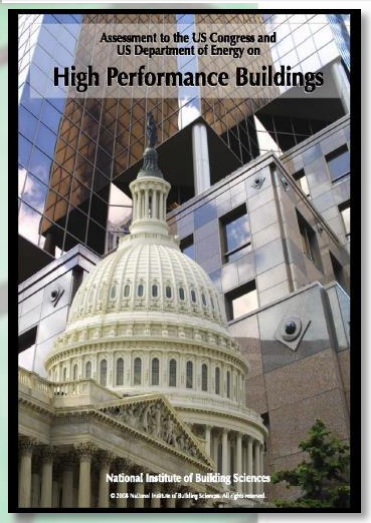
Roger Grant

National Institute of Building Sciences

U.S. DEPARTMENT OF ENERGY

National Institute of BUILDING SCIENCES
An Authoritative Source of Innovative Solutions for the Built Environment

High Performance Building Council
a council of the National Institute of Building Sciences



Defining Zero Energy Buildings

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Roger Grant
Program Director
National Institute of Building Sciences

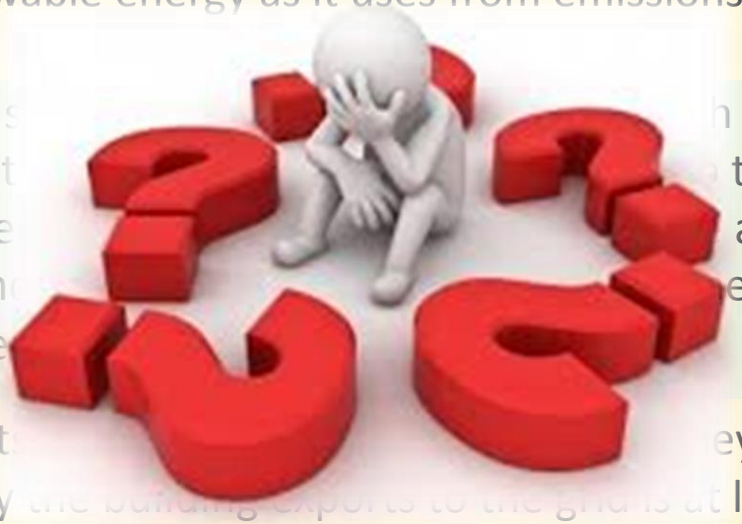
Project Background

- Buildings identified as (Net) Zero Energy (Ready) are becoming more prevalent
- There is a growing number of local, regional, and other definitions
- This can lead to confusion and uncertainty in claims, which might hamper organic growth of ZEB's and rigor of voluntary and mandatory programs
- There is a federal role in initiating the development of a common, clear national definition

What are Zero Energy Buildings?

Net Zero Site Energy: A site ZEB produces at least as much energy as it uses in a year, when accounted for at the site.

Net Zero Energy Emissions: A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.



Net Zero Source Energy: A s energy as it uses in a year, when accounted for at the primary energy used to generate and delive a building's total source energy, imported an e appropriate site-to-source conversion multiplie

Net Zero Energy Cost y the utility pays the building owner for the energy the building exports to the grid is at least equal to the amount the owner pays the utility for the energy services and energy used over the year.

The amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building. A ZNE building may also consider embodied energy –the quantity of energy required to manufacture and supply to the point of use, the materials utilized for its building.

Existing Definitions

nbi new buildings institute

NREL

GSA

INTERNATIONAL LIVING FUTURE INSTITUTE

DEPARTMENT OF DEFENSE · UNITED STATES OF AMERICA

architecture 2030

…….. And More

Project Goal

Converge on an industry-accepted national DOE definition for ZE that will support program and policy goals and encourage commercial new construction and major renovation projects to design, construct, and operate buildings that achieve a high level of energy efficiency.

Project Guiding Principles

A commercial zero energy building (ZEB) definition should:

- Create a standardized basis for identification of ZEBs for use by industry.
- Be capable of being measured and verified, and should be rigorous and transparent.
- Influence the design and operation of buildings to substantially reduce building operational energy consumption.
- Be clear and easy to understand by the industry and policy makers.
- Be durable, needing only infrequent updates.

Definition Development Process Overview

1. Established project goals
2. Conducted literature review
3. Interviewed Subject Matter Experts
4. Compiled results and prepared draft definitions, framework, nomenclature and metrics
5. Convened Stakeholders to review results and discuss next steps needed
6. Revised draft definitions, circulated for SME and Stakeholder feedback
7. Public comment period – Completed
8. Develop and publish common ZEB definitions, guidelines, nomenclature and metrics that can be broadly accepted

Proposed Zero Energy Building (ZEB) Definition

- *An energy-efficient (**building**)* where the **actual annual source energy** consumption is balanced by **on-site** renewable energy**.*

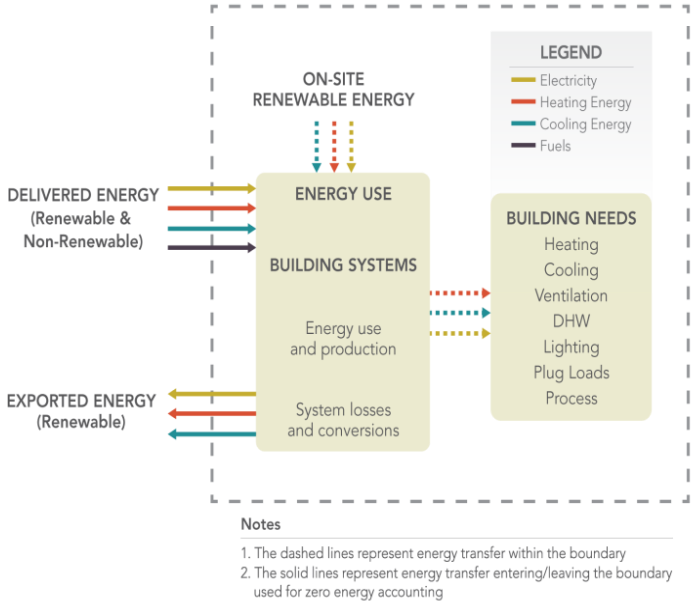
* The term “building” could be replaced by – campus, portfolio, community.
** Physical site boundary = energy boundary (building, campus, portfolio, community).

Nomenclature

- Annual
- Building
- Building energy
- Campus
- Community
- Delivered energy
- Energy
- Exported energy
- On-site renewable energy
- Portfolio
- Renewable energy
- Site boundary
- Source energy

Measurement and Implementation Guidelines

1. Measurement boundaries for all definitions
2. Energy accounting and measurements
3. Source energy calculations



Energy Type	ENERGY STAR Source-Site Ratio, r
Electricity	3.14
Natural Gas	1.05
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.20
Hot Water	1.20
Chilled Water	1.00
Wood	1.0
Coal/Coke	1.0

Status and Next Steps

1. Conducted research and developed draft material
2. Held stakeholder workshop
3. Revised definitions and nomenclature, developed implementation guidelines with SME/Stakeholder input
4. Conducted formal public comment period
5. Collected and analyzing comments
6. Publish common definitions, nomenclature and guidelines

Resources

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www.nibs.org
www.wbdg.org

Roy Torbert & Roy Buchert

Rocky Mountain Institute & McDonald's

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MCDONALD'S NET ZERO ENERGY STUDY:

INSIGHTS FOR THE QSR INDUSTRY

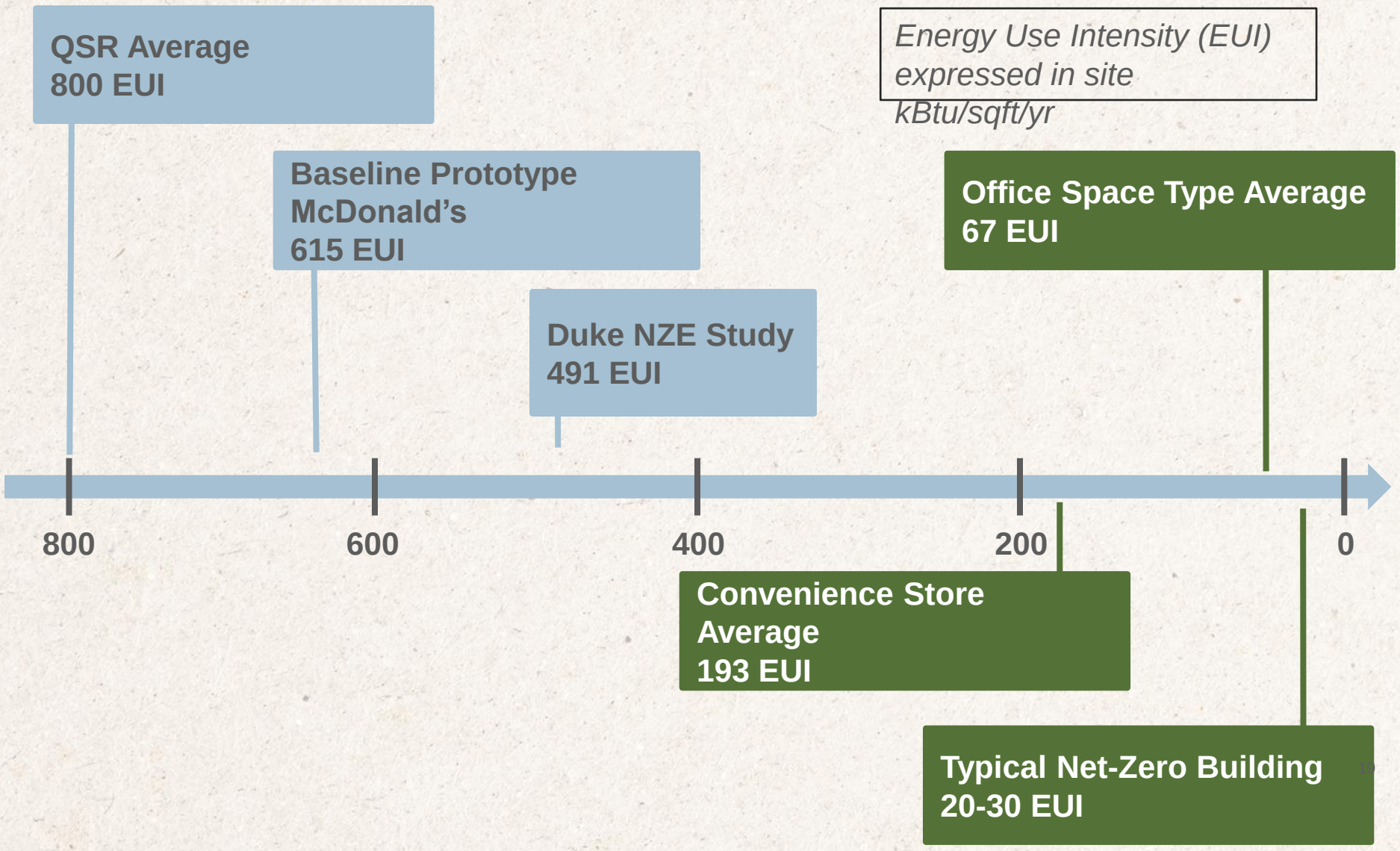
APRIL 7TH, 2015

FISHER NICKEL Inc.

nbi new buildings institute

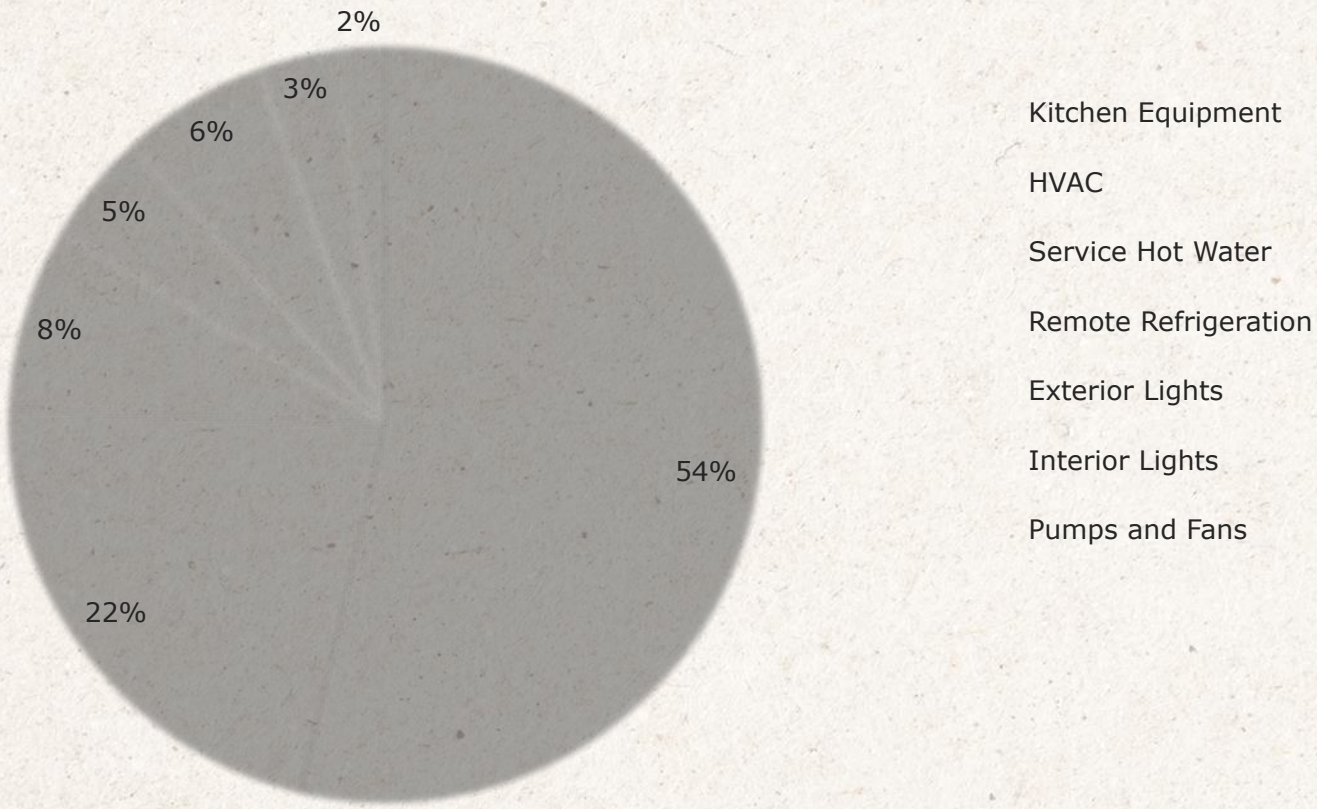
ROCKY MOUNTAIN INSTITUTE

NZE FOR QSRS IS A CHALLENGE COMPARED TO OTHER BUILDING TYPES

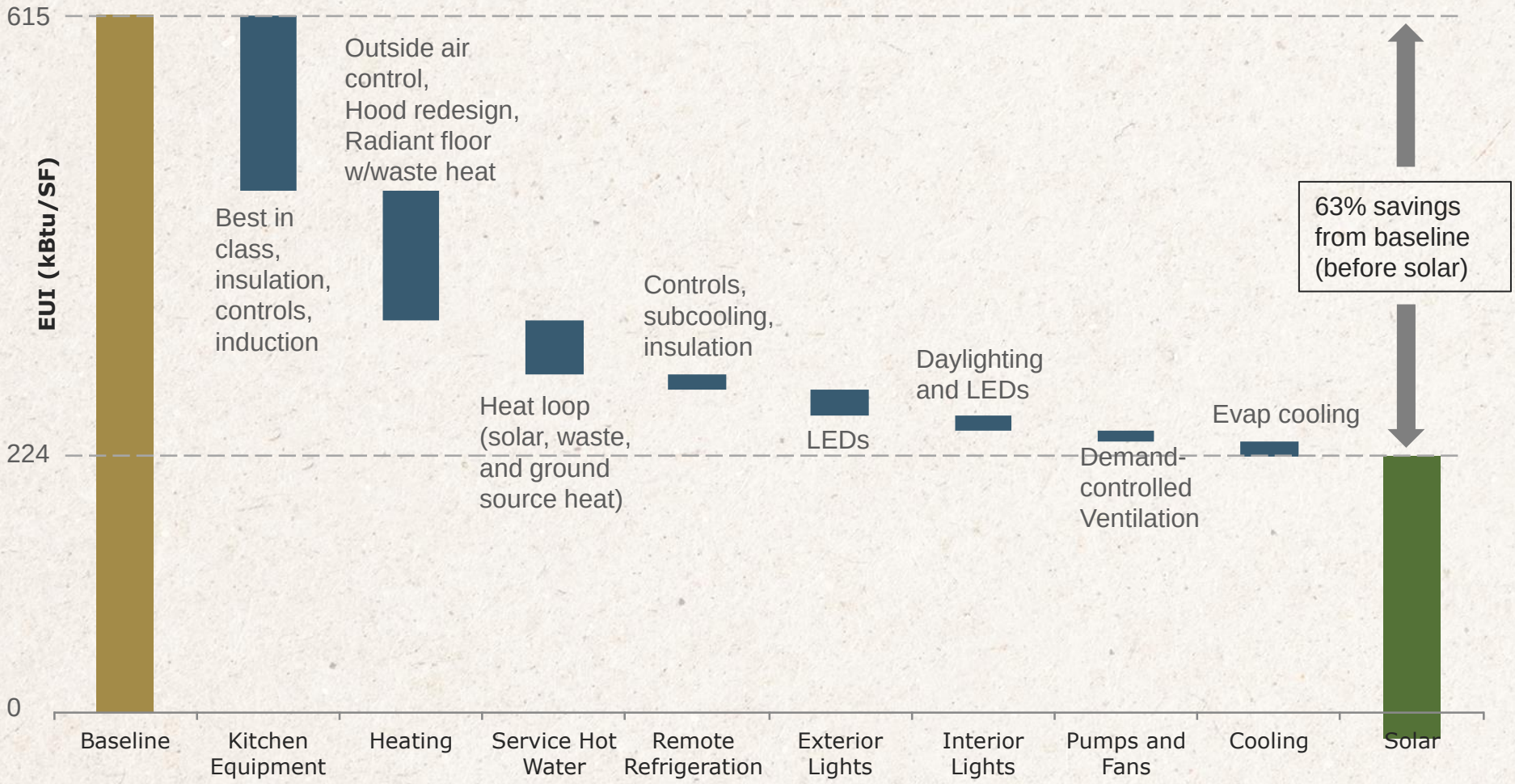


KITCHEN EQUIPMENT DOMINATES ENERGY LOAD, BUT OTHER FACTORS ARE ALSO IMPORTANT

Baseline McDonald's Energy Use

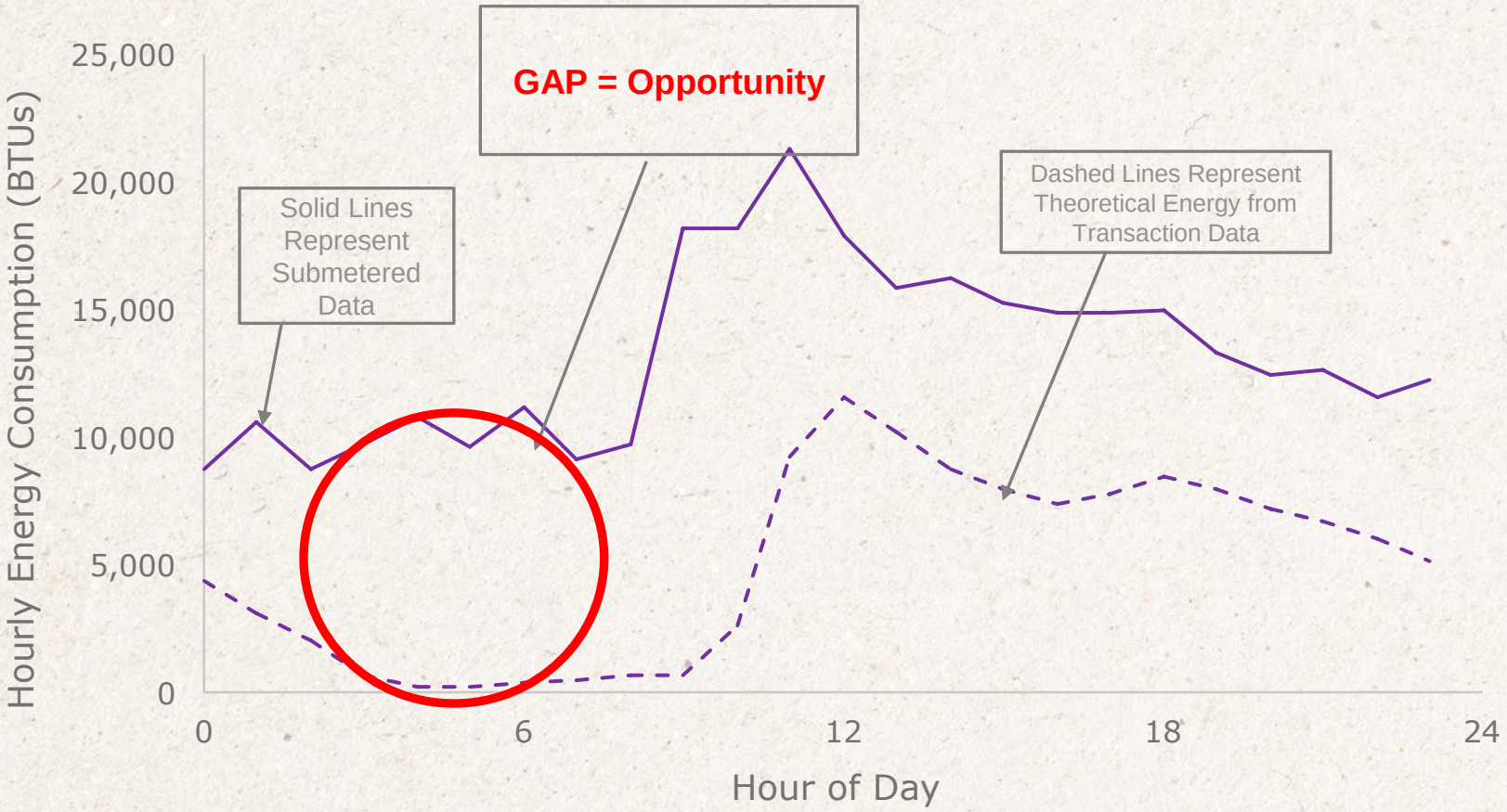


HOLISTIC ENERGY SOLUTION CAN REDUCE ENERGY INTENSITY BY OVER 60%



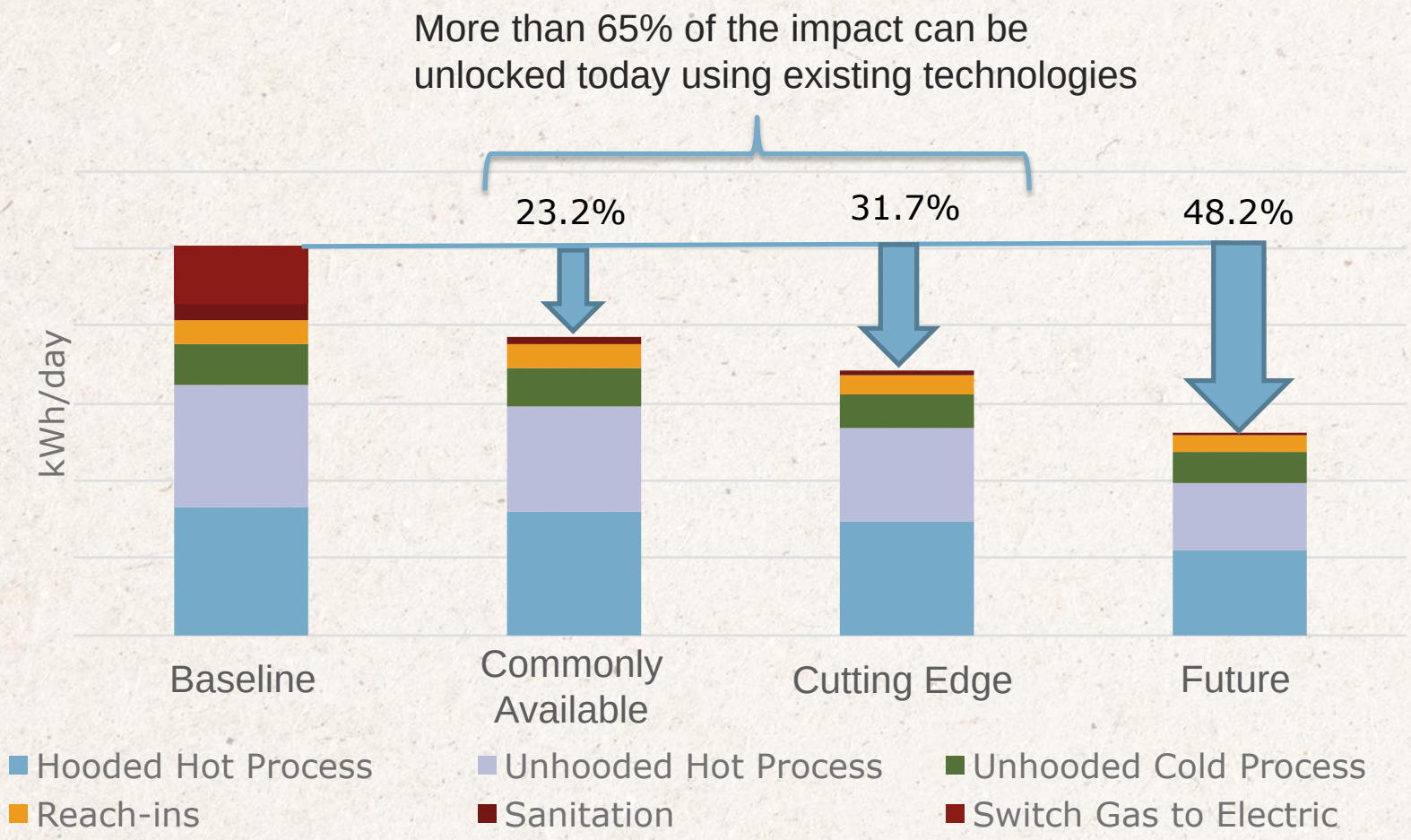
KEY THEME:
REDUCE KITCHEN ENERGY CONSUMPTION

Kitchen energy consumption has the most potential for further energy reductions

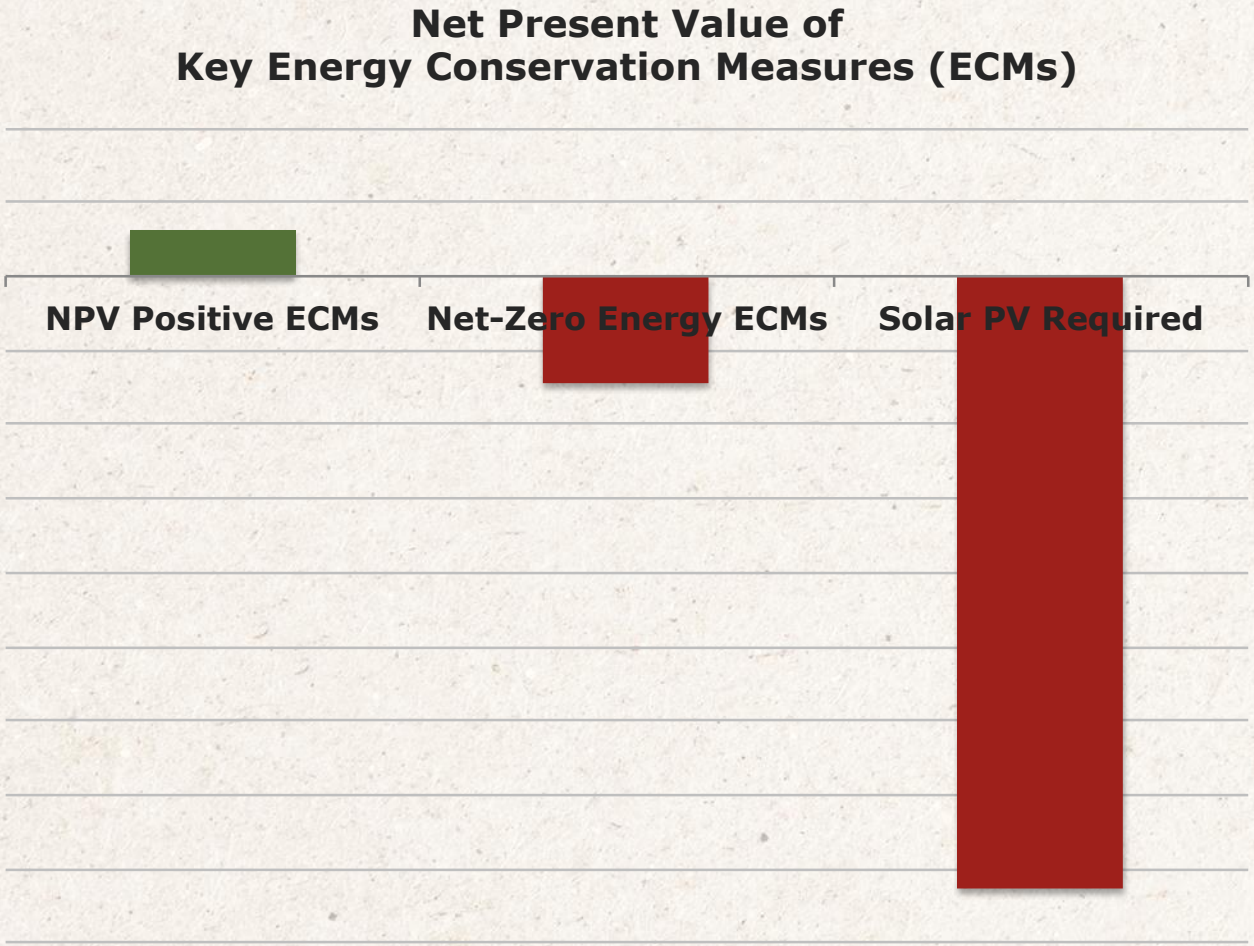


LARGE FRACTION OF PROPOSED KITCHEN SAVINGS CAN BE ACHIEVED WITH AVAILABLE TECHNOLOGIES

Energy Savings by Kitchen Equipment Category



SOLAR ECONOMICS KEY TO COST-EFFECTIVE NZE

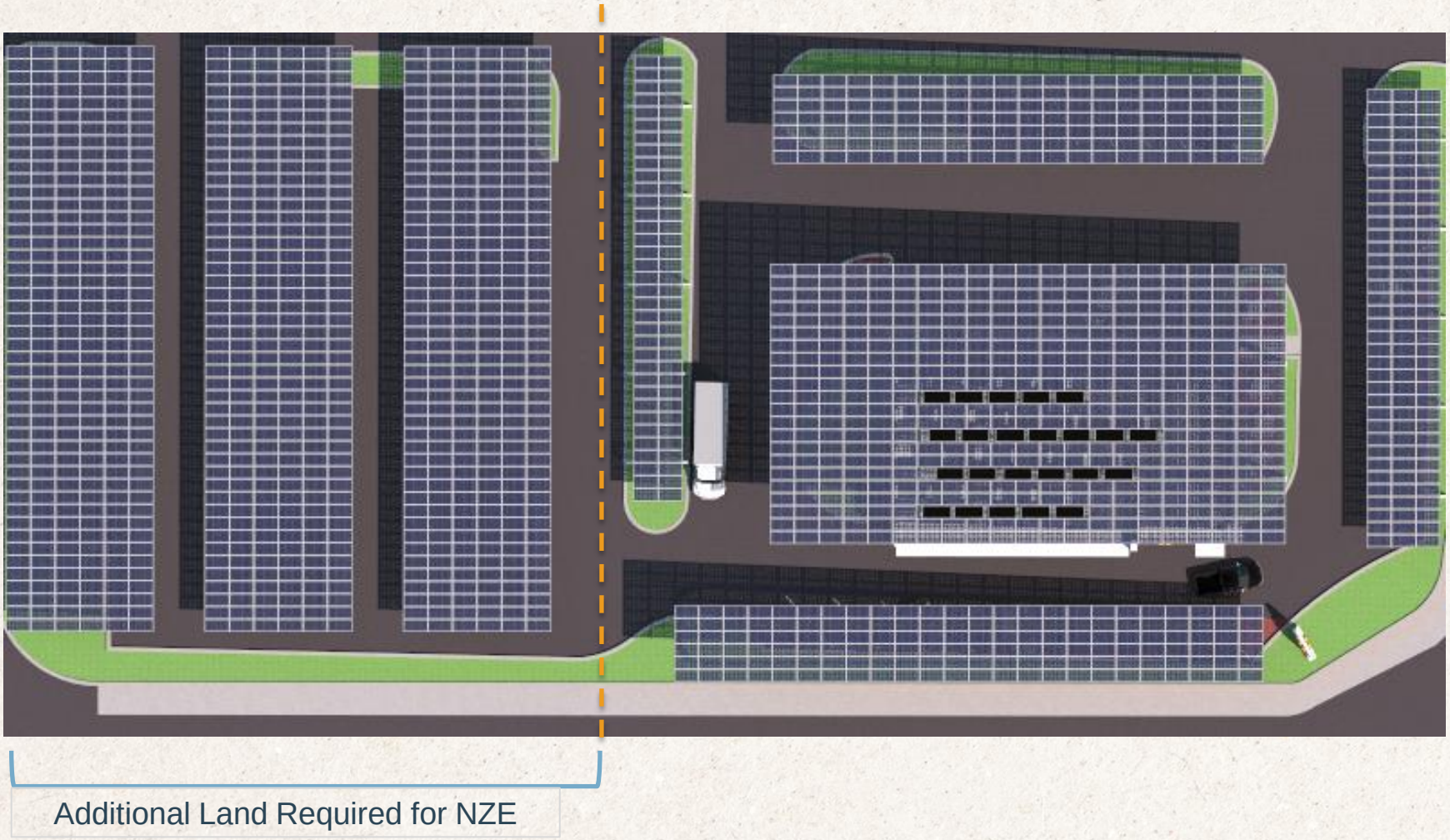


- Substantial savings possible from non-solar technology improvements
- NPV negative ECMs currently more cost effective than solar PV
- Cost effective NZE for QSRs will require development on several fronts
  - Additional NPV positive ECMs
  - Continued cost reduction of solar PV
  - Options to access lower cost renewable energy (e.g. community solar)

Source: Team analysis

WITHOUT EFFICIENCY SUBSTANTIAL ADDITIONAL LAND REQUIRED TO ACHIEVE NZE

Net Zero Energy with 2013 Prototype Restaurant



EFFICIENCY ALLOWS NZE ON EXISTING LAND

Net Zero Energy Recommended Scenario

No Additional Land Required

RMI rendering of the NZE McDonald's Concept

KEY THEMES

1. **Systems thinking and integrative design** are paramount
2. **Efficiency before renewable supply** is most cost effective
3. **Transparency and collaboration** with and between suppliers
4. **Transparency of performance** about critical pieces of equipment
5. **Kitchen energy consumption has the most potential** for further energy reductions
6. **Operations don’t need to change significantly,** but can unlock opportunities
7. **Many of the ECMs identified are cost-effective** over the life of the equipment

NEXT STEPS

1. Review & prioritize recommended energy efficiency strategies to **further improve kitchen equipment efficiency** and **reduce costs.**

2. **Engage with the restaurant industry and suppliers** as appropriate to help drive improvements

RMI rendering of the NZE McDonald's Concept

3. **Apply efficiency solutions that make sense to new and existing restaurants**

4. **Potentially design and build a pilot NZE restaurant** in the future to act as a "learning lab" to test and validate new technologies

Thank you
We Look Forward to your questions

RMI rendering of the NZE McDonald's Concept

Jason Robbins

Walgreens

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Walgreens
AT THE CORNER OF HAPPY & HEALTHY®

Walgreens Boot Alliance

We are a leader in the pharmacy & convenience store industry with 12,800 locations in 25 countries

- 12,800 drugstores
- 340 distribution centers
  - Distributing to more than 180,000 pharmacies
- Infusion and respiratory services facilities
- Specialty pharmacies
- Mail service facilities
- More than 700 in-store care clinics & worksite health & wellness centers (Take Care Health Systems)

Walgreens Boots Alliance

Walgreens

drugstore.com
the uncommon drugstore

BEAUTY.COM

DR
DUANE reade

take care clinic
at select Walgreens

Vision

To create a showcase for innovative, sustainable, high-performance design at a retail location without altering the operational characteristics of the store in order to make it as highly-scalable as possible. To share this information with the sustainability, architecture, and retail communities in a completely transparent fashion as a means of encouraging the adoption of green building practices wherever reasonably feasible.

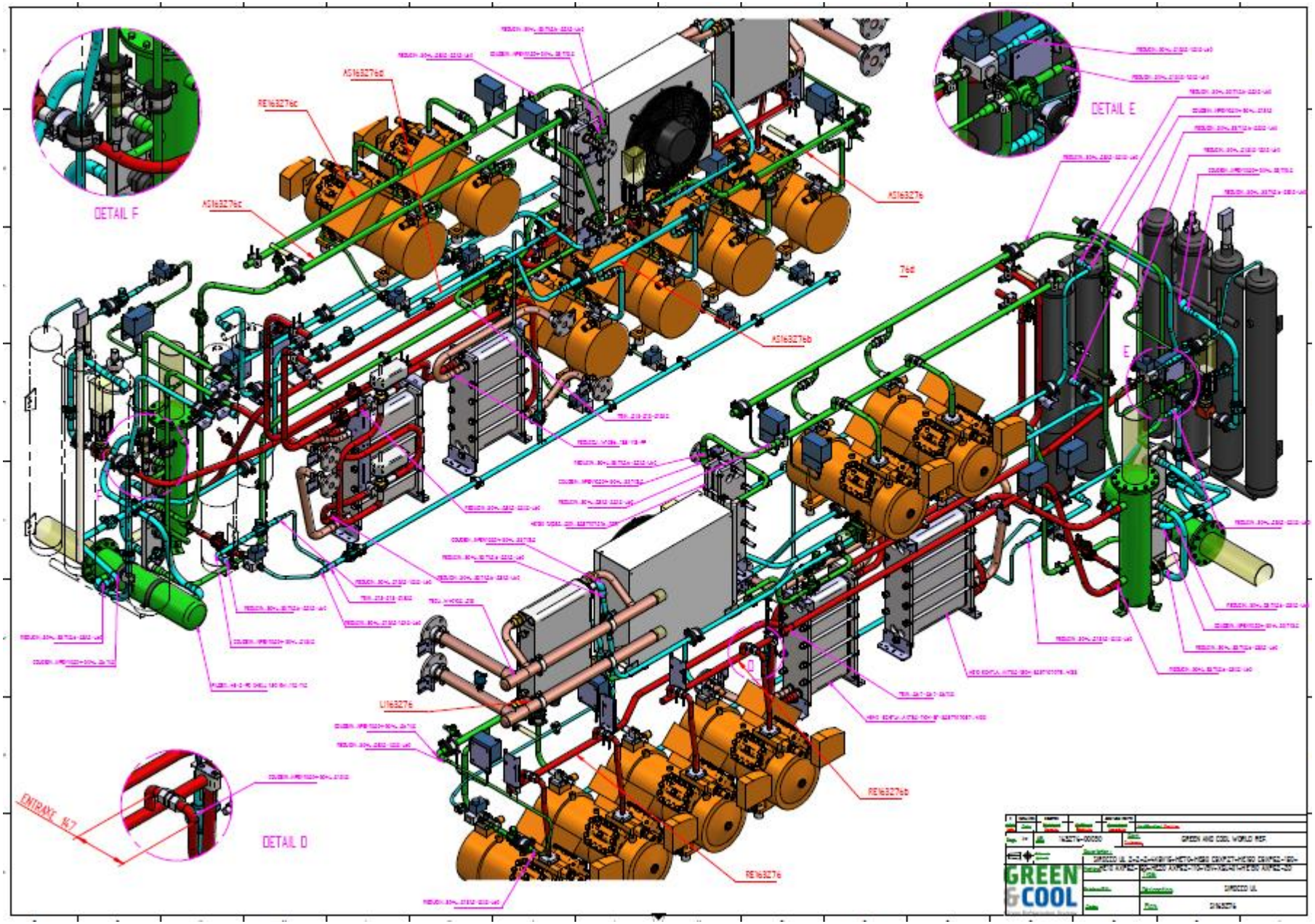

Walgreens

Project goals

- First net-zero energy retail store in the US
- LEED Platinum Certification
- Living Building Challenge Net Zero Certification
- Better Building Challenge Showcase project
- Green Chill Platinum certification
- ENERGY STAR
- Open before Thanksgiving 2013 (14 months for design & construction)

Energy reduction strategies

- Ultra-high-efficiency mechanical and refrigeration system with carbon dioxide as the refrigerant
  - Uses 8 geothermal bore holes, each 550’ deep, as main heat source and heat sink
- All LED lighting
- Daylight harvesting
- Natural ventilation with operable windows
- 5 separate dimming zones, including peak output reduction after dark
- Revolving door
- Building automation system and a weather station to allow building systems to react to local climate conditions


DETAIL F
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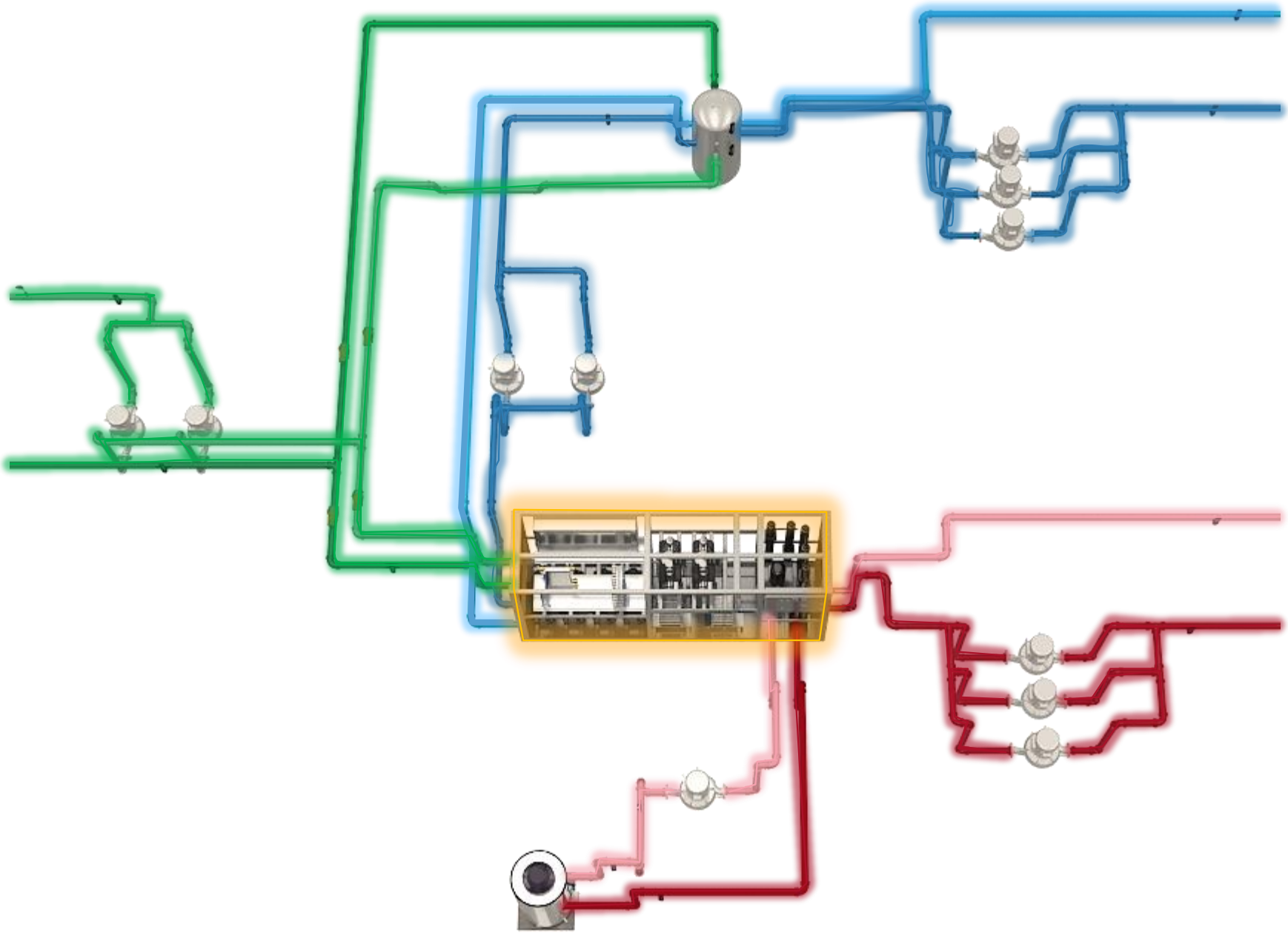
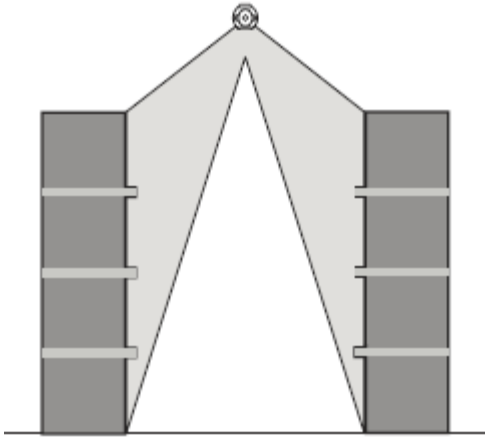


All LED Lighting

- Lighting Power Density of .9 W/sf
- 5 daylighting zones in sales area
- Directional light distribution pattern to illuminate shelving and product
- Reduced HVAC load by 2.3 Tons




Well at Walgreens
naturals
lotion
beautiful

It’s not just about energy . . .

- Recycled of over 84% of the existing building
- Used natural and adaptive plant species and eliminated water used for irrigation
- All low flow water fixtures
- Stormwater from the site is captured beneath the parking lot and allowed to percolate back into the soil
- Low-VOC finishes and fixtures used throughout the space
- Electric vehicle charging station
- Educational signage throughout the site, including a viewable mechanical space.

Happy and healthy

Today, our appreciation for this Chicagoland-based mega company has hit an all-time high.

Good For You Walgreens: First Net-Zero Retail Store

Walgreen Co. is getting behind the "green" part of its name.

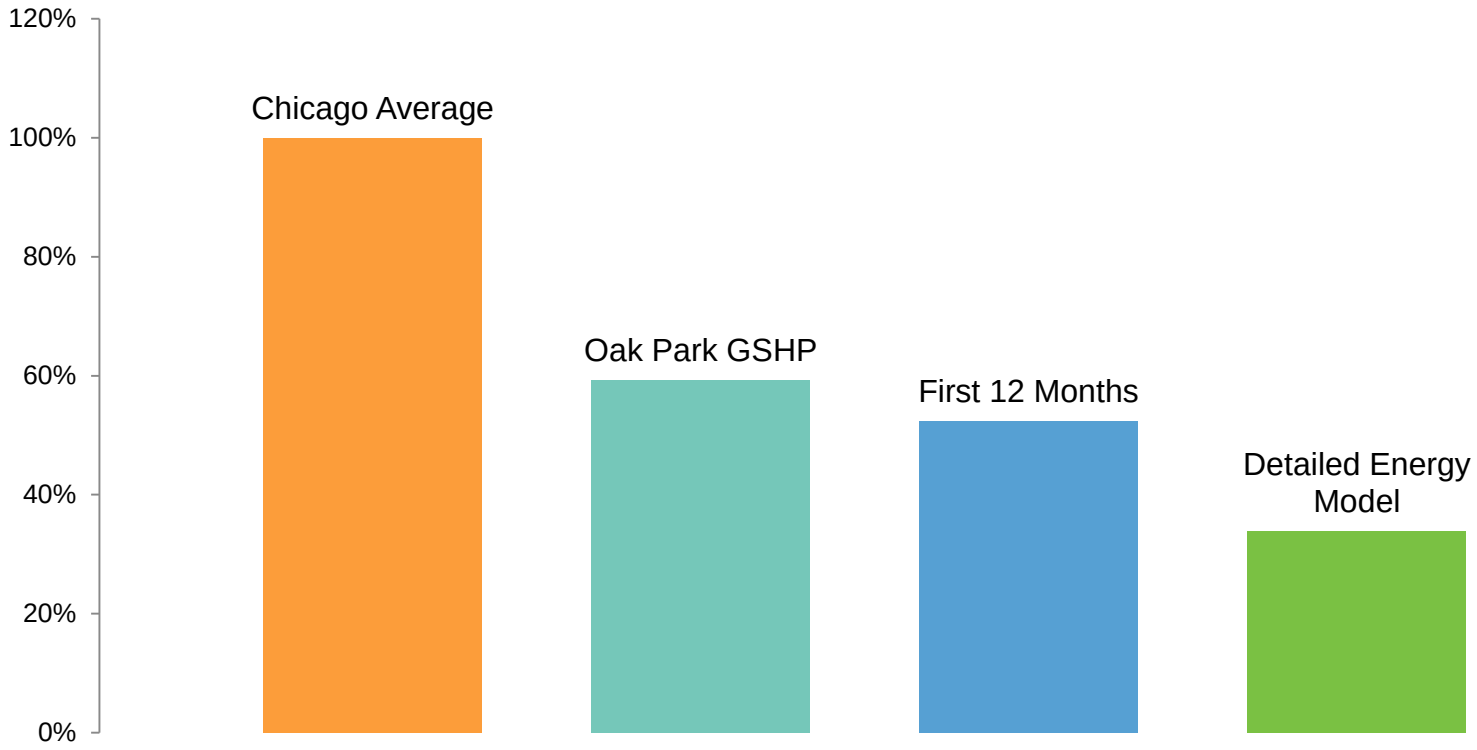
Who would guess that Walgreens, the largest US drugstore chain, would become an environmental leader?

Walgreens does the right thing, again

Walgreens Continues Journey Into Future

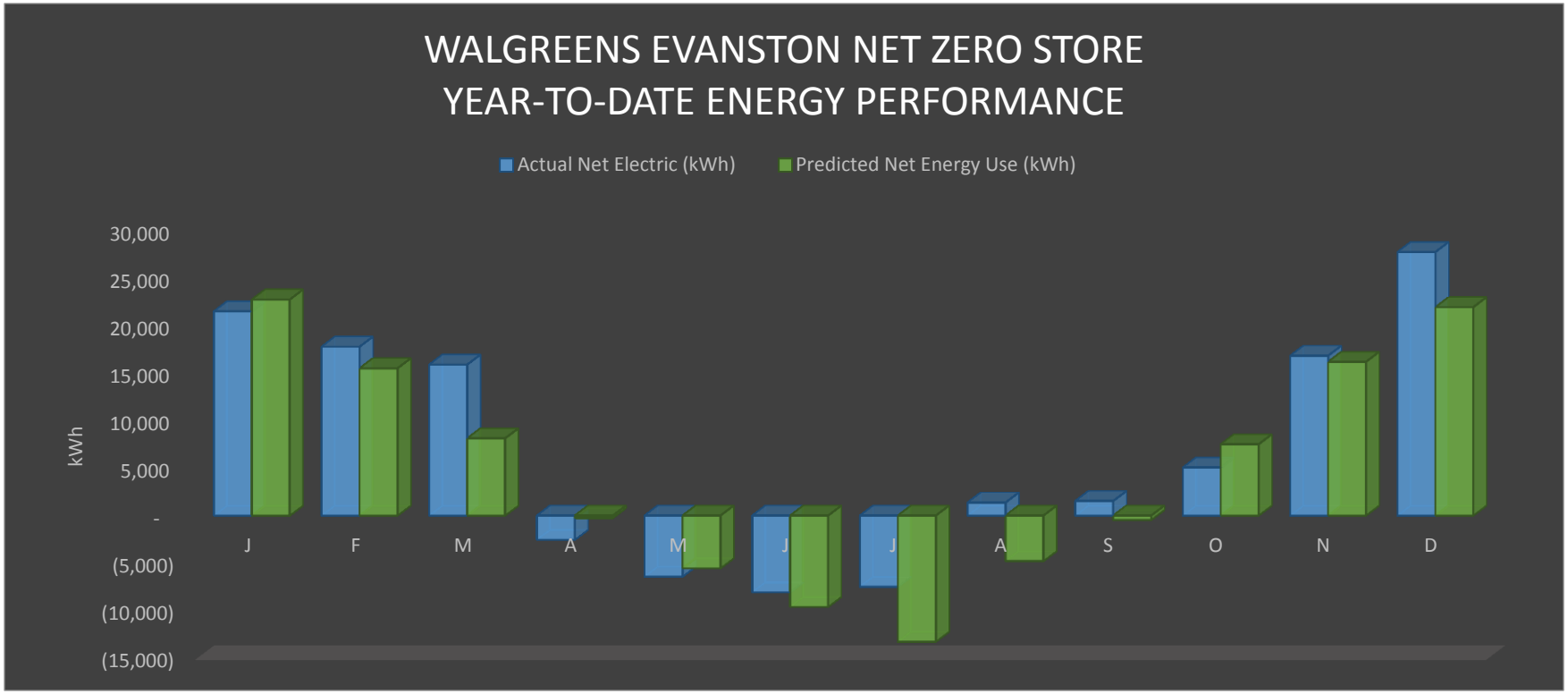
Sometimes **Walgreens** really just blows our socks off.

The Results

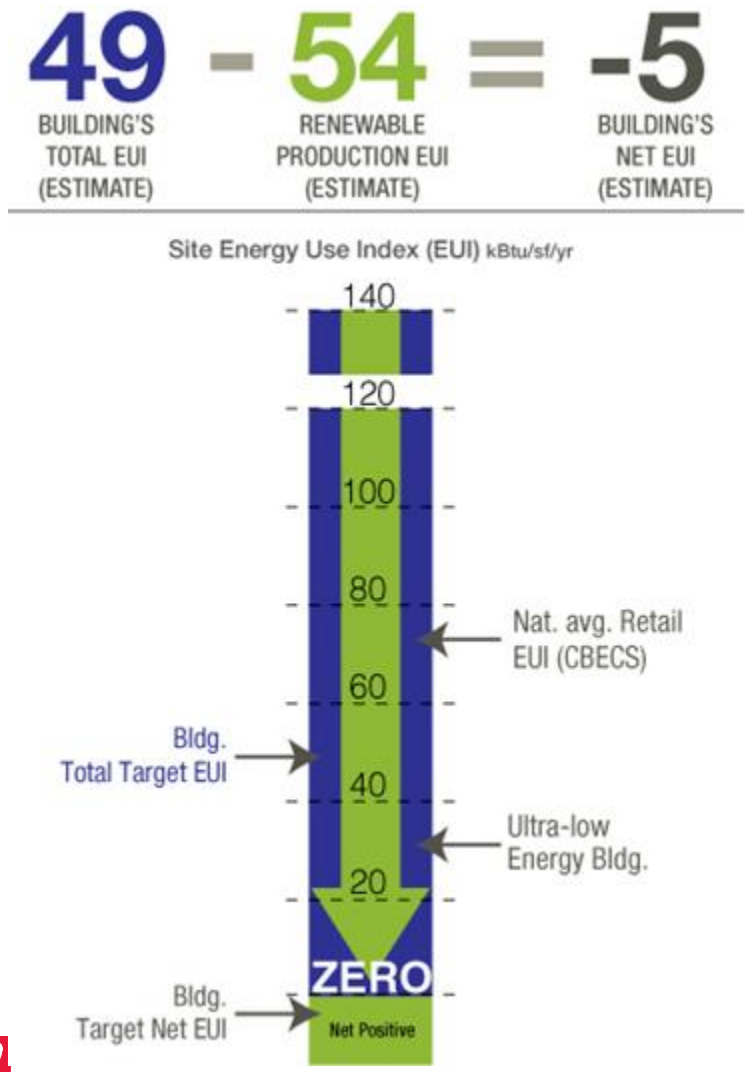


Net zero predicted energy use comparison (not including solar and wind energy production)

The Results



The Results



Predicted EUI = -5

Actual EUI after 1st year of operation = 20

Several corrective measures taken from issues found during commissioning.

- Replacing oversized refrigeration compressors
- Re-piping dedicated outside air handler
- Diagnosing and repairing anti-condensate heaters
- Dimming system properly set up
- Replaced incorrect lighting fixtures
- Security system lighting override
- Malfunctioning Gas cooler

Additional Resources

U.S. DEPARTMENT OF ENERGY

For More Information

- National Institute of Building Science
  - Sign up for project notifications
- Rocky Mountain Institute
  - Efficiency and Renewables on the Menu for McDonald's
- Walgreens
  - Net Zero Energy Retail Store showcase project
  - Press Release
  - Facebook page
- Department of Energy
  - Zero Energy Buildings definition project (to go live in coming weeks)

Q & A

U.S. DEPARTMENT OF ENERGY

Join us at the Better Buildings Summit

Registration is now open!

WHO: 800+ Better Buildings partners and stakeholders and nearly 200 speakers will share demonstrated and proven solutions.

WHAT: 2 ½ days of sessions and meetings focused on the sharing of the most successful energy efficiency strategies. There will be plenty of time for attendees to ask questions, network, and exchange new ideas.

WHEN: May 27-29, 2015

WHERE: Washington D.C.

Quick links:

- Agenda at-a-glance
- Register today
- Reserve your hotel room

It only happens once a year, so don't miss it!

Additional Questions? Feel Free to Contact Us

betterbuildingswebinars@ee.doe.gov

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